Environmental Science, Semester A

Course Overview and Goals

Environmental Science explores the biological, physical, and sociological principles related to the environment in which organisms live on Earth: the biosphere. Course topics include natural systems on Earth, biogeochemical cycles, the nature of matter and energy, the flow of matter and energy through living systems, populations, communities, ecosystems, ecological pyramids, renewable and nonrenewable natural resources, land use, biodiversity, pollution, conservation, sustainability, and human impacts on the environment.

The course provides students with opportunities to learn and practice scientific skills within the context of relevant scientific questions. Scientific inquiry skills are embedded in the direct instruction, wherein students learn to ask scientific questions, deconstruct claims, form and test hypotheses, and use logic and evidence to draw conclusions about the concepts. Case studies of current environmental challenges introduce each content lesson and acquaint students with real-life environmental issues, debates, and solutions. Lab activities reinforce critical thinking, writing, and communication skills and help students develop a deeper understanding of the nature of science. Virtual labs enable students to engage in investigations that would otherwise require long periods of observation at remote locations and to explore simulations that enable environmental scientists to test predictions. Throughout this course, students are given an opportunity to understand how biology, earth science, and physical science are applied to the study of the environment and how technology and engineering are contributing solutions for studying and creating a sustainable biosphere.

This course is built to state standards.

By the end of this course, you will be able to do the following:

- Analyze interactions within and between systems that are the focus of environmental science, from the biosphere to the geosphere.
- Predict how the movement of matter and energy through various systems leads to environmental changes.
- Interpret the impact of human populations on the environment and vice versa.

Lab materials needed for this course

Course Components and Grading Rubric

The table gives a breakdown of the weight for each component in the course. Weight represents the percentage of the total score coming from each activity.

Course Components	Count	Weight
Pretest. *A pretest is an optional assessment, typically designed for credit recovery. If a student shows mastery of a lesson objective, the student may be automatically exempted from the upcoming activities associated with the mastered objective. Each passing pretest grade is entered into the gradebook.*	4	0%
Practice. *A practice activity provides instruction similar to that found in a study so that students can practice or review skills necessary to complete their assignment with mastery.*	7	5%
Discussion. *A discussion activity is an opportunity for students to collaborate with their peers. This activity gives students the opportunity to practice speaking and listening in a clear and logical manner and to receive feedback from peers.*	4	5%
Explore. *An explore activity gives students the opportunity to conduct research, evaluate source materials, and synthesize information.*	4	5%
Project. *A project is a hands-on investigation that extends over several weeks.*	2	5%
Lab. *A lab is a hands-on investigatory activity that can be completed in a couple of class periods. It can include virtual labs, modeling exercises, and engineering design activities.*	4	10%
Mastery Test. *A mastery test is a computer-scored lesson-level summative assessment.*	30	30%
Posttest. *A posttest appears at the end of each unit.*	4	15%
End-Of-Semester Test. *An end-of-semester test (EOS) appears at the end of each course.*	1	5%
Teacher-Graded Posttest. *A posttest that prompts students for written responses appears at the end of each unit.*	4	15%
Teacher-Graded End-Of-Semester Test. *An end-of-semester test (EOS) that prompts students for written responses appears at the end of each course.*	1	5%

Course Components	Count	Weight
Total	**65**	**100%**

**Teachers may manually adjust these weights if desired, per district grading requirements.*

UNIT 1: INTRODUCTION TO ENVIRONMENTAL SCIENCE

In this unit, you will define environmental science and apply tools of scientific inquiry to analyze data.

Lesson and Duration	Activities	Objectives
What Is Science? *3 hours, 50 minutes*	*Overview: What Is Science?* *Study: The Nature of Science* *Mastery Test: The Nature of Science* *Study: The Practice of Science* *Mastery Test: The Practice of Science* *Checkup: What Is Science?*	• Distinguish what science is from what science is not. • Identify scientists throughout time and from all parts of Earth who have been observing the natural world. • Recognize how scientific data and conclusions can be reliable and valid, yet open to change. • Define each of the basic parts that may compose the scientific process and that produce valid and reliable data. • Summarize the importance of logical reasoning, experimentation, empirical evidence, argumentation, and ethics in scientific endeavors.
Science and the Environment *5 hours, 35 minutes*	*Overview: Science and the Environment* *Study: Fields of Science* *Mastery Test: Fields of Science* *Study: Applied Science and Technology* *Mastery Test: Applied Science and Technology*	• Identify fields of science that contribute to the study and understanding of the interrelated, dynamic systems of Earth's environment. • Relate examples of environmental studies and equipment to specialized fields of science.

Lesson and Duration	Activities	Objectives
	Explore: GPS and GIS Technology *Practice: Science and the Environment*	• Recommend areas of expertise that might contribute information relevant to specific environmental issues. • Interpret the role of technology in environmental science and human society. • Identify commonly used devices, systems, and sources of information important to environmental studies. • Research online to collect information about, and use, GPS and GIS technology. • Examine the validity and impact of scientific research on environmental issues related to human activities.
Doing Science: Introduction to Environmental Science *3 hours*	*Overview: Doing Science: Introduction to Environmental Science* *Study: Investigate Cycling of Oxygen Gas and Carbon Dioxide Gas* *Mastery Test: Investigate Cycling of Oxygen Gas and Carbon Dioxide Gas* *Lab: Investigate Cycling of Oxygen Gas and Carbon Dioxide Gas* *Discussion: Investigate Cycling of Oxygen Gas and Carbon Dioxide Gas*	• Research the cycling of oxygen gas and carbon dioxide gas. • Formulate a hypothesis and design a controlled experiment to test it. • Identify common laboratory tools and techniques used to conduct the experiment you designed. • Conduct a scientific investigation, using a scientific process and demonstrating the proper and safe use of laboratory equipment. • Analyze data by using data tables, by calculating the range and average of a set of measurements, and by identifying sources of error.

Lesson and Duration	Activities	Objectives
		• Evaluate lab procedures and results in a discussion with your peers.
Wrap-Up: Introduction to Environmental Science *2 hours*	*Review: Introduction to Environmental Science* *Posttest: Introduction to Environmental Science* *Teacher-Graded Posttest: Introduction to Environmental Science*	• Review key ideas presented in the unit. • Demonstrate mastery of concepts and skills from the unit by completing a computer-scored assessment. • Demonstrate mastery of concepts and skills from the unit by completing a teacher-scored assessment.

UNIT 2: EARTH'S PHYSICAL SYSTEMS

In this unit, you will compare the characteristics of Earth's hydrosphere, atmosphere, and geosphere.

Lesson and Duration	Activities	Objectives
The Hydrosphere *8 hours, 50 minutes*	*Overview: The Hydrosphere* *Study: The Oceans* *Mastery Test: The Oceans* *Study: Bodies of Freshwater* *Mastery Test: Bodies of Freshwater* *Study: Movements of the Hydrosphere* *Mastery Test: Movements of the Hydrosphere* *Practice: The Hydrosphere*	• Summarize the reasons that liquid water can exist on Earth. • Examine the formation of and characteristics of the major types of bodies of water. • Relate solar energy to ocean currents and the distribution of heat around the globe. • Identify reasons for fluctuations in sea level. • Determine the causes and effects of ocean waves and tides. • Recognize the path of groundwater from soil to the ocean.

Lesson and Duration	Activities	Objectives
	Project: Explore Your Local Physical Environment	• Research and summarize the physical features and abiotic factors that characterize the geographical area in which you live.
The Lithosphere *7 hours, 5 minutes*	*Overview: The Lithosphere* *Study: Earth's Crust and Landforms* *Mastery Test: Earth's Crust and Landforms* *Study: Soil Composition and Structure* *Mastery Test: Soil Composition and Structure* *Study: Movements of Land and Soil* *Mastery Test: Movements of Land and Soil* *Checkup: The Lithosphere* *Explore: Earthquake Prediction and Readiness*	• Relate the surface features of Earth's crust to the theory of plate tectonics. • Distinguish erosional features and depositional features of Earth's crust. • Identify the types of weathering and the agents of each type of weathering. • Differentiate among the types of soil and the processes of soil formation. • Identify the types of erosion and their effects on Earth's crust. • Relate movements of the crust to the forces created by interactions of tectonic plates. • Create models to illustrate how Earth's internal and surface processes form continental and ocean-floor features.
The Atmosphere *4 hours, 5 minutes*	*Overview: The Atmosphere* *Study: Structure and Movements of the Atmosphere* *Mastery Test: Structure and Movements of the Atmosphere* *Study: Weather and Climate* *Mastery Test: Weather and Climate*	• Recognize the structure, composition, and temperature of Earth's atmosphere. • Identify the processes of wind generation and relate them to different types of local and global wind systems. • Examine the major climate zones and their characteristics.

Lesson and Duration	Activities	Objectives
	Practice: The Atmosphere	• Determine how ocean currents, wind patterns, and topography affect climate. • Summarize how Earth's orbit, tilt, and wobble affect the planet's climate. • Evaluate the effects of El Niño and La Niña on global weather patterns. • Analyze geoscience data to explain how Earth's surface temperatures affect atmospheric conditions.
Doing Science: Earth's Physical Systems *3 hours*	*Overview: Doing Science: Earth's Physical Systems* *Study: Investigate Weathering and Erosion* *Mastery Test: Investigate Weathering and Erosion* *Lab: Investigate Weathering and Erosion* *Discussion: Investigate Weathering and Erosion*	• Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. • Formulate a hypothesis and design a controlled experiment to test it. • Identify common laboratory tools and techniques used to conduct the experiment you designed. • Conduct a scientific investigation, using a scientific process and demonstrating the proper and safe use of laboratory equipment. • Analyze data by using data tables, by calculating the range and average of a set of measurements, and by identifying sources of error. • Evaluate lab procedures and results in a discussion with your peers.

Lesson and Duration	Activities	Objectives
Wrap-Up: Earth's Physical Systems *2 hours*	*Review: Earth's Physical Systems* *Posttest: Earth's Physical Systems* *Teacher-Graded Posttest: Earth's Physical Systems*	• Review key ideas presented in the unit. • Demonstrate mastery of concepts and skills from the unit by completing a computer-scored assessment. • Demonstrate mastery of concepts and skills from the unit by completing a teacher-scored assessment.

UNIT 3: THE BIOSPHERE

In this unit, you will evaluate the interactions between and within ecosystems.

Lesson and Duration	Activities	Objectives
Nature of the Biosphere *7 hours, 5 minutes*	*Overview: Nature of the Biosphere* *Study: Biotic and Abiotic Factors* *Mastery Test: Biotic and Abiotic Factors* *Study: Biogeochemical Cycles* *Mastery Test: Biogeochemical Cycles* *Practice: Nature of the Biosphere* *Project: Explore Your Local Ecosystem*	• Recognize the major types of biotic factors in an ecosystem and their roles in the biosphere. • Distinguish among biological species, populations, and communities. • Identify the abiotic factors in an ecosystem and their importance to living organisms. • Summarize how biotic factors interact with the abiotic factors of an ecosystem. • Recognize the movement of water, nitrogen, and phosphorus from one part of the environment to another.

Lesson and Duration	Activities	Objectives
		• Analyze the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere, using computer simulations and other models. • Analyze geoscience data to explain how Earth's surface temperatures affect the biosphere.
Matter and Energy in the Biosphere *4 hours, 5 minutes*	*Overview: Matter and Energy in the Biosphere* *Study: Matter and Energy* *Mastery Test: Matter and Energy* *Study: The Flow of Matter and Energy* *Mastery Test: The Flow of Matter and Energy* *Practice: Matter and Energy in the Biosphere*	• Recognize the major types of matter that make up the biosphere. • Identify the forms of energy that enter and flow through the biosphere. • Examine the processes that transform energy as it moves through the biosphere. • Develop a model to illustrate how photosynthesis transforms light energy into stored chemical energy. • Apply mathematical representations to trace matter moving through the Calvin cycle. • Create a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. • Compare the characteristics of different surfaces on Earth, including albedo and heat capacity.

Lesson and Duration	Activities	Objectives
Ecosystems and Biomes *7 hours, 5 minutes*	*Overview: Ecosystems and Biomes* *Study: Terrestrial Biomes* *Mastery Test: Terrestrial Biomes* *Study: Aquatic Ecosystems* *Mastery Test: Aquatic Ecosystems* *Study: Land Ecosystems* *Mastery Test: Land Ecosystems* *Checkup: Ecosystems and Biomes* *Explore: The Importance of Coral Reefs*	• Examine characteristics of land ecosystems. • Recognize characteristics of aquatic ecosystems. • Identify the major land and aquatic biomes. • Identify the distinguishing biotic and abiotic features of a given biome. • Evaluate the importance of individual ecosystems to the health of biomes and the biosphere. • Compare the plants and animals of your local biome with the other major biomes found in North America. • Discuss the validity and impact of scientific research on environmental issues related to human activities.
Doing Science: The Biosphere *3 hours*	*Overview: Doing Science: The Biosphere* *Study: Investigate Using a Dichotomous Key* *Mastery Test: Investigate Using a Dichotomous Key* *Lab: Investigate Using a Dichotomous Key* *Discussion: Investigate Using a Dichotomous Key*	• Recognize the use of dichotomous keys in the identification of plants and animals. • Formulate a hypothesis and design a controlled experiment to test it. • Identify common laboratory tools and techniques used to conduct the experiment you designed. • Conduct a scientific investigation, using a scientific process and demonstrating the proper and safe use of laboratory equipment.

Lesson and Duration	Activities	Objectives
		• Analyze data by using data tables, by calculating the range and average of a set of measurements, and by identifying sources of error. • Evaluate lab procedures and results in a discussion with your peers.
Wrap-Up: The Biosphere *2 hours*	*Review: The Biosphere* *Posttest: The Biosphere* *Teacher-Graded Posttest: The Biosphere*	• Review key ideas presented in the unit. • Demonstrate mastery of concepts and skills from the unit by completing a computer-scored assessment. • Demonstrate mastery of concepts and skills from the unit by completing a teacher-scored assessment.

UNIT 4: ECOLOGY

In this unit, you will determine how nature and populations, especially human populations, leave an impact on each other.

Lesson and Duration	Activities	Objectives
Populations *4 hours, 5 minutes*	*Overview: Populations* *Study: Characteristics of Populations* *Mastery Test: Characteristics of Populations* *Study: Population Growth* *Mastery Test: Population Growth* *Practice: Populations*	• Recognize characteristics used to describe populations. • Identify limiting factors that affect populations and their characteristics. • Identify a population's carrying capacity and the factors that determine the carrying capacity, using a computer simulation. • Determine how populations change in size.

Lesson and Duration	Activities	Objectives
		• Examine the factors that produce both positive and negative population growth. • Compare exponential and logistic patterns of population growth. • Recognize the significance of studying populations over time.
Communities *5 hours, 50 minutes*	*Overview: Communities* *Study: What Is a Biological Community?* *Mastery Test: What Is a Biological Community?* *Study: Species Interactions* *Mastery Test: Species Interactions* *Study: Community Structure* *Mastery Test: Community Structure* *Practice: Communities*	• Differentiate biological communities from populations and ecosystems. • Summarize the parts of a food chain. • Identify major types of biological communities. • Classify the types of interactions that occur among the species in biological communities. • Recognize the nature and importance of an ecological niche. • Analyze food chains, food webs, and ecological pyramids that describe the interactions of species in a biological community. • Calculate the amount of energy that flows through different trophic levels of a community.
Changes in Ecosystems *5 hours, 20 minutes*	*Overview: Changes in Ecosystems* *Study: Natural Disturbances and Succession* *Mastery Test: Natural Disturbances and Succession* *Study: Evolution and Biodiversity*	• Evaluate evidence to identify the factors that affect community stability and biodiversity. • Determine how destructive natural events in the geosphere can affect ecosystems. • Identify the effects of the removal of species from biological communities.

Lesson and Duration	Activities	Objectives
	Mastery Test: Evolution and Biodiversity *Checkup: Changes in Ecosystems* *Explore: Biodiversity Hot Spots*	• Predict the effects of the introduction of non-native species on communities. • Summarize the sources and importance of genetic diversity in natural populations, ecosystems, and the biosphere. • Examine changes that may occur in ecosystems when its amount of biodiversity changes.
Doing Science: Ecology *3 hours*	*Overview: Doing Science: Ecology* *Study: Investigate Cycling of Matter and Energy* *Mastery Test: Investigate Cycling of Matter and Energy* *Lab: Investigate Cycling of Matter and Energy* *Discussion: Investigate Cycling of Matter and Energy*	• Create a model ecosystem to investigate the water cycle and the cycling of oxygen and carbon dioxide among living things. • Formulate a hypothesis, and design a controlled experiment to test it. • Recognize common laboratory tools and techniques used to conduct the experiment you designed. • Conduct a scientific investigation, using a scientific process and demonstrating the proper and safe use of laboratory equipment. • Analyze data by using data tables, by calculating the range and average of a set of measurements, and by identifying sources of error. • Evaluate lab procedures and results in a discussion with your peers.
Wrap-Up: Ecology *2 hours*	*Review: Ecology* *Posttest: Ecology*	• Review key ideas presented in the unit.

Lesson and Duration	Activities	Objectives
	Teacher-Graded Posttest: Ecology	• Demonstrate mastery of concepts and skills from the unit by completing a computer-scored assessment. • Demonstrate mastery of concepts and skills from the unit by completing a teacher-scored assessment.

SEMESTER WRAP-UP

Lesson and Duration	Activities	Objectives
Semester Wrap-Up *2 hours, 40 minutes*	*Review: Semester Review* *End-of-Semester Test: Semester Exam* *Teacher-Graded End-of-Semester Test: Semester Exam*	• Review key ideas presented in the semester. • Demonstrate mastery of concepts and skills from the semester by completing a computer-scored assessment. • Demonstrate mastery of concepts and skills from the semester by completing a teacher-scored assessment.